Technical Note 1967-54

S. D. Weiner

Tables of Hemisphere Scattering Amplitude for Nose-On Incidence

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MASSACHUSETTS INSTITUTE OF TECHNOLOGY
Lexington, Massachusetts

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Group 41

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ABSTRACT

Tables of the electromagnetic scattering amplitude and cross section of a conducting hemisphere for nose-on incidence are presented as a function of frequency, bistatic angle and polarization. The tables give the real and imaginary parts of the scattering amplitude and the lar cross section normalized to πR^2 (R = hemisphere radius). Results are shown for kR ($k = 2\pi/\lambda$) from .2 to 20.0 in steps of .2, for bistatic angles from 0° to 150° in steps of 30° and for both HH and VV polarizations.

Accepted for the Air Force
Franklin C. Hudson
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Explanation of Tables

The scattering amplitude of a conducting hemisphere of radius R for nose-on incidence was calculated numerically using the formal solution of Kennaugh.[1] This solution is also outlined in Ref. 2. The geometry of the hemisphere scattering is shown in Fig. 1 which indicates the bistatic angle and the two polarizations considered. The tables give the real and imaginary parts of the scattering amplitude, A, and the radar cross section, σ, as functions of $kR = 2\pi R/\lambda$ and bistatic angle for both polarizations. The amplitude and cross section are normalized so that

$$\frac{\sigma}{\pi R^2} = \left| A \right|^2 \qquad (1)$$

It may be seen that for backscattering, the scattering amplitude is polarization independent. Since the computational requirements increase rapidly with kR, it is felt that the results for small kR are considerably more accurate than those for large kR. All the data presented should be accurate to at least two significant figures. For $kR \leq 10$, the four significant figures given in the tables should be correct.

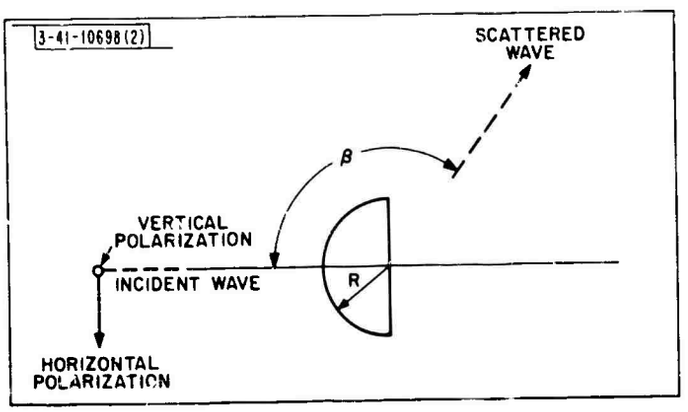

Fig. 1. Geometry of hemisphere scattering.

REFERENCES

1. E. M. Kennaugh, "The Scattering of Plane Electromagnetic Waves by a Perfectly Conducting Hemisphere or Hemispherical Shell," Ohio State University, Antenna Lab., Project Report 302-35, (15 May 1950).

2. S. D. Weiner, "Short-Pulse Scattering by a Hemisphere," Tech. Report 436, Lincoln Laboratory, M.I.T. (18 July 1967).

TABLE 1

Real (A^{HH})

KR	BISTATIC ANGLE (DEGREES) 0	30	60	90	120	150
0.200	-0.008	-0.070	-0.053	-0.031	0.008	-0.009
0.400	-0.075	-0.274	-0.207	-0.115	0.024	-0.044
0.600	-0.196	-0.594	-0.440	-0.234	0.031	-0.120
0.800	-0.331	-1.019	-0.724	-0.351	-0.005	-0.266
1.000	-0.467	-1.412	-0.958	-0.430	-0.035	-0.359
1.200	-0.602	-1.671	-1.075	-0.452	-0.035	-0.342
1.400	-0.783	-1.752	-1.070	-0.436	0.003	-0.237
1.600	-0.963	-1.673	-0.991	-0.437	0.124	-0.004
1.800	-1.114	-1.466	-0.809	-0.382	0.189	0.120
2.000	-1.219	-1.140	-0.547	-0.306	0.257	0.221
2.200	-1.234	-0.729	-0.224	-0.227	0.329	0.262
2.400	-1.144	-0.256	0.154	-0.115	0.391	0.336
2.600	-0.963	0.212	0.547	0.020	0.424	0.401
2.800	-0.647	0.611	0.913	0.178	0.412	0.448
3.000	-0.301	0.889	1.220	0.361	0.380	0.601
3.200	-0.045	1.013	1.417	0.536	0.272	0.594
3.400	0.151	0.980	1.481	0.684	0.136	0.544
3.600	0.301	0.810	1.381	0.743	0.030	0.403
3.800	0.361	0.628	1.256	0.584	0.097	0.176
4.000	0.331	0.539	1.474	0.523	0.240	0.182
4.200	0.196	0.224	1.269	0.865	-0.124	0.426
4.400	0.0	-0.038	0.754	0.842	-0.327	0.722
4.600	-0.226	-0.213	0.296	0.757	-0.437	0.884
4.800	-0.467	-0.270	-0.141	0.614	-0.609	0.707
5.000	-0.692	-0.180	-0.514	0.386	-0.726	0.536
5.200	-0.933	-0.004	-0.748	0.148	-0.782	0.432
5.400	-1.084	0.310	-0.883	-0.171	-0.816	0.280
5.600	-1.069	0.669	-0.884	-0.490	-0.811	0.132
5.800	-0.918	1.002	-0.793	-0.786	-0.767	-0.086
6.000	-0.647	1.150	-0.596	-0.823	-0.423	-0.093
6.200	-0.286	2.052	-0.785	-1.091	-0.737	-0.077
6.400	0.105	2.036	-0.305	-1.340	-0.702	-0.365
6.600	0.421	1.899	0.103	-1.396	-0.590	-0.462
6.800	0.647	1.674	0.363	-1.333	-0.418	-0.606
7.000	0.737	1.324	0.544	-1.164	-0.178	-0.613
7.200	0.722	0.894	0.572	-0.830	-0.003	-0.721
7.400	0.467	0.508	0.454	-0.343	0.013	-0.649
7.600	0.120	0.329	0.161	-0.112	0.162	-0.811
7.800	-0.226	-0.005	-0.032	0.124	0.426	-1.101
8.000	-0.572	-0.277	-0.259	0.372	0.663	-1.113
8.200	-0.843	-0.615	-0.218	0.356	0.427	-0.297
8.400	-1.008	-0.129	-0.821	0.921	1.025	-1.093
8.600	-1.084	0.011	-0.999	1.146	1.168	-1.113
8.800	-0.993	0.272	-1.109	1.259	1.222	-1.100
9.000	-0.737	0.571	-1.109	1.282	1.222	-1.071
9.200	-0.391	0.848	-0.996	1.218	1.174	-1.037
9.400	-0.060	1.070	-0.838	1.048	1.056	-0.999
9.600	0.271	1.160	-0.534	0.826	0.933	-0.960
9.800	0.557	1.100	-0.173	0.532	0.737	-0.928
10.000	0.707	0.849	0.412	0.068	0.437	-1.071

TABLE 1 (Continued)

Real (A^{HH})

KR	BISTATIC ANGLE (DEGREES) 0	30	60	90	120	150
10.200	0.737	0.566	0.642	-0.060	0.335	-0.711
10.400	0.632	0.018	1.132	-0.278	0.281	-0.602
10.600	0.406	-0.382	1.287	-0.714	0.060	-0.761
10.800	0.105	-0.811	1.435	-0.936	-0.023	-0.713
11.000	-0.196	-1.126	1.372	-0.952	-0.339	-0.425
11.200	-0.542	-1.343	1.205	-0.962	-0.624	-0.314
11.400	-0.753	-1.427	0.952	-0.920	-0.853	-0.224
11.600	-0.933	-1.410	0.629	-0.846	-1.071	-0.119
11.800	-0.978	-1.210	0.258	-0.673	-1.210	-0.046
12.000	-0.888	-0.903	-0.103	-0.461	-1.301	0.032
12.200	-0.677	-0.466	-0.391	-0.189	-1.320	0.085
12.400	-0.331	-0.120	-0.710	0.212	-0.859	-0.431
12.600	0.0	0.050	-0.809	0.263	-1.332	0.188
12.800	0.346	0.286	-0.809	0.462	-1.216	0.294
13.000	0.617	0.332	-0.777	0.603	-1.042	0.365
13.200	0.783	0.278	-0.596	0.703	-0.841	0.465
13.400	0.813	-0.003	-0.461	0.888	-0.482	0.674
13.600	0.662	-0.241	-0.014	0.675	-0.427	0.603
13.800	0.421	-0.584	0.243	0.629	-0.237	0.798
14.000	0.090	-1.014	0.442	0.489	-0.063	0.797
14.200	-0.256	-1.298	0.653	0.189	0.285	0.721
14.400	-0.587	-1.453	0.711	-0.031	0.622	0.790
14.600	-0.858	-1.538	0.698	-0.231	0.862	0.771
14.800	-0.978	-1.441	0.487	-0.487	1.017	0.785
15.000	-0.963	-1.159	0.286	-0.615	1.221	0.894
15.200	-0.828	-0.798	-0.014	-0.741	1.313	0.929
15.400	-0.557	-0.372	-0.353	-0.768	1.383	0.953
15.600	-0.196	0.065	-0.680	-0.733	1.401	0.977
15.800	0.166	0.486	-0.919	-0.619	1.385	0.997
16.000	0.497	0.778	-1.125	-0.477	1.235	1.062
16.200	0.737	0.943	-1.204	-0.238	1.155	0.958
16.400	0.858	0.961	-1.162	-0.001	0.969	0.931
16.600	0.813	0.784	-1.097	0.171	0.654	0.763
16.800	0.647	0.585	-0.730	0.478	0.595	0.631
17.000	0.361	0.277	-0.372	0.647	0.392	0.685
17.200	0.015	0.026	0.101	0.781	0.187	0.655
17.400	-0.331	-0.293	0.448	0.954	-0.174	0.637
17.600	-0.647	-0.510	0.786	1.001	-0.478	0.550
17.800	-0.858	-0.599	1.053	0.953	-0.740	0.450
18.000	-0.948	-0.607	1.190	0.851	-0.937	0.388
18.200	-0.903	-0.415	1.237	0.650	-1.126	0.279
18.400	-0.722	-0.123	1.126	0.435	-1.272	0.251
18.600	-0.436	0.314	1.004	0.084	-1.367	0.008
18.800	-0.090	0.769	0.674	-0.227	-1.462	-0.087
19.000	0.271	1.107	0.351	-0.527	-1.433	-0.218
19.200	0.467	1.364	-0.007	-0.791	-1.362	-0.350
19.400	0.632	1.531	-0.281	-1.014	-1.203	-0.415
19.600	0.768	1.485	-0.547	-1.161	-1.086	-0.516
19.800	0.858	1.316	-0.733	-1.204	-0.882	-0.607
20.000	0.918	1.082	-0.775	-1.165	-0.660	-0.664

TABLE 2

Imag (A^{HH})

KR	BISTATIC ANGLE (DEGREES) 0	30	60	90	120	150
0.200	0.085	-0.005	-0.002	0.001	-0.002	-0.001
0.400	0.421	-0.044	-0.014	0.009	-0.012	-0.001
0.600	0.918	-0.132	-0.040	0.027	-0.027	0.019
0.800	1.309	-0.240	-0.066	0.049	-0.015	0.116
1.000	1.610	-0.348	-0.092	0.058	0.045	0.313
1.200	1.791	-0.468	-0.162	0.011	0.151	0.555
1.400	1.957	-0.650	-0.323	-0.115	0.271	0.747
1.600	1.942	-0.899	-0.527	-0.256	0.353	0.859
1.800	1.776	-1.120	-0.780	-0.476	0.470	0.956
2.000	1.475	-1.277	-1.013	-0.711	0.586	1.041
2.200	1.099	-1.302	-1.230	-0.973	0.704	1.120
2.400	0.707	-1.248	-1.336	-1.159	0.784	1.196
2.600	0.346	-1.086	-1.343	-1.284	0.834	1.263
2.800	0.060	-0.829	-1.242	-1.333	0.863	1.320
3.000	-0.151	-0.489	-0.955	-1.288	0.919	1.428
3.200	-0.181	-0.109	-0.646	-1.201	0.962	1.484
3.400	0.015	0.277	-0.255	-1.060	1.033	1.537
3.600	0.361	0.621	0.182	-0.881	1.153	1.531
3.800	0.828	0.937	0.838	-0.573	1.292	1.768
4.000	1.309	0.949	1.284	0.228	0.980	2.244
4.200	1.746	0.727	1.190	0.709	0.740	2.436
4.400	2.077	0.591	1.282	0.927	0.782	2.607
4.600	2.227	0.239	1.262	1.219	0.622	2.266
4.800	2.182	-0.128	1.137	1.419	0.490	2.082
5.000	1.926	-0.511	0.935	1.540	0.368	2.000
5.200	1.520	-0.945	0.657	1.585	0.225	1.923
5.400	1.129	-1.174	0.364	1.553	0.062	1.878
5.600	0.768	-1.264	0.059	1.450	-0.105	1.838
5.800	0.467	-1.059	-0.275	1.291	-0.259	1.833
6.000	0.256	-0.606	-0.755	1.150	-0.450	1.935
6.200	0.196	-0.314	-0.508	0.319	-1.097	1.355
6.400	0.256	-0.121	-0.453	0.087	-1.050	1.266
6.600	0.421	0.106	-0.326	-0.190	-1.099	1.185
6.800	0.722	0.468	-0.167	-0.495	-1.168	1.077
7.000	1.084	0.762	0.040	-0.741	-1.244	1.052
7.200	1.400	1.096	0.194	-0.972	-1.395	0.758
7.400	1.686	1.263	0.336	-1.211	-1.435	0.543
7.600	1.926	1.057	0.656	-1.548	-1.143	0.075
7.800	2.047	0.685	0.880	-1.549	-0.986	0.020
8.000	2.002	0.186	1.018	-1.452	-0.885	0.087
8.200	1.806	0.064	0.991	-1.357	-0.653	0.245
8.400	1.505	-0.417	0.584	-0.844	-0.364	-0.629
8.600	1.129	-0.614	0.318	-0.584	-0.229	-0.695
8.800	0.798	-0.761	-0.019	-0.275	-0.048	-0.786
9.000	0.482	-0.758	-0.398	0.043	0.155	-0.888
9.200	0.316	-0.610	-0.771	0.345	0.366	-0.988
9.400	0.166	-0.380	-1.084	0.559	0.561	-1.028
9.600	0.316	-0.015	-1.325	0.765	0.764	-1.144
9.800	0.542	0.371	-1.423	0.871	0.928	-1.248
10.000	0.888	0.817	-1.479	1.152	1.345	-1.053

TABLE 2 (Continue.)

Imag (A^{HH})

KR	BISTATIC ANGLE (DEGREES) 0	30	60	90	120	150
10.200	1.294	1.048	-1.362	1.120	1.401	-1.101
10.400	1.701	1.278	-0.947	0.769	1.529	-1.650
10.600	2.047	1.261	-0.641	0.684	1.584	-1.373
10.800	2.212	1.243	-0.340	0.670	1.373	-1.081
11.000	2.212	1.039	0.019	0.462	1.211	-1.083
11.200	2.107	0.705	0.407	0.190	1.088	-1.115
11.400	1.821	0.322	0.737	-0.070	0.943	-1.105
11.600	1.475	-0.141	1.008	-0.311	0.757	-1.067
11.800	1.054	-0.461	1.121	-0.497	0.541	-1.035
12.000	0.692	-0.672	1.106	-0.626	0.311	-0.998
12.200	0.421	-0.664	0.928	-0.667	0.118	-1.007
12.400	0.226	-0.760	0.714	-0.868	-0.196	-0.793
12.600	0.256	-0.363	0.526	-0.579	-0.548	-0.649
12.800	0.391	-0.057	0.191	-0.461	-0.729	-0.622
13.000	0.662	0.181	-0.107	-0.300	-0.96	-0.564
13.200	1.023	0.518	-0.376	-0.076	-1.129	-0.458
13.400	1.445	0.705	-0.507	0.034	-1.408	-0.505
13.600	1.776	1.079	-0.563	0.275	-1.480	-0.392
13.800	2.002	1.062	-0.549	0.479	-1.572	-0.335
14.000	2.137	0.975	-0.348	0.472	-1.445	-0.458
14.200	2.122	0.793	-0.097	0.532	-1.337	-0.339
14.400	1.941	0.379	0.154	0.587	-1.279	-0.245
14.600	1.731	-0.099	0.314	0.425	-1.066	0.035
14.800	1.400	-0.492	0.571	0.478	-0.927	0.193
15.000	1.023	-0.815	0.789	0.289	-0.724	0.165
15.200	0.707	-1.011	0.921	0.037	-0.507	0.218
15.400	0.497	-1.137	0.905	-0.132	-0.254	0.297
15.600	0.361	-1.116	0.775	-0.357	0.014	0.385
15.800	0.281	-0.974	0.515	-0.561	0.285	0.533
16.000	0.421	-0.720	0.141	-0.638	0.704	0.331
16.200	0.662	-0.347	-0.182	-0.810	0.879	0.523
16.400	1.038	0.030	-0.541	-0.897	1.078	0.597
16.600	1.415	0.433	-0.819	-1.036	1.229	0.477
16.800	1.701	0.544	-1.147	-0.723	1.458	0.822
17.000	1.927	0.679	-1.283	-0.599	1.511	0.866
17.200	2.062	0.629	-1.408	-0.319	1.493	1.019
17.400	2.062	0.445	-1.319	-0.060	1.403	1.022
17.600	1.896	0.161	-1.101	0.191	1.333	1.034
17.800	1.580	-0.194	-0.786	0.451	1.216	1.051
18.000	1.249	-0.626	-0.429	0.701	1.059	1.060
18.200	0.903	-0.964	-0.029	0.920	0.867	1.071
18.400	0.632	-1.175	0.378	1.133	0.696	1.196
18.600	0.421	-1.265	0.711	1.141	0.371	0.978
18.800	0.301	-1.226	0.988	1.106	0.071	0.956
19.000	0.361	-1.053	1.105	1.054	-0.176	0.910
19.200	0.497	-0.748	1.102	0.917	-0.401	0.831
19.400	0.722	-0.455	1.020	0.703	-0.798	0.866
19.600	1.009	-0.040	0.763	0.439	-0.929	0.805
19.800	1.520	0.361	0.469	0.163	-1.094	0.759
20.000	2.077	0.668	0.196	-0.250	-1.361	0.590

TABLE 3

Real (A^{VV})

KR	BISTATIC ANGLE (DEGREES) 0	30	60	90	120	150
0.200	-0.008	-0.072	-0.061	-0.045	-0.030	-0.019
0.400	-0.075	-0.283	-0.240	-0.183	-0.126	-0.084
0.600	-0.196	-0.618	-0.527	-0.410	-0.294	-0.208
0.800	-0.331	-1.075	-0.924	-0.736	-0.553	-0.415
1.000	-0.467	-1.508	-1.285	-1.015	-0.755	-0.555
1.200	-0.602	-1.805	-1.507	-1.159	-0.823	-0.555
1.400	-0.783	-1.913	-1.557	-1.160	-0.771	-0.447
1.600	-0.963	-1.853	-1.496	-1.091	-0.645	-0.219
1.800	-1.114	-1.676	-1.346	-0.981	-0.548	-0.099
2.000	-1.219	-1.394	-1.131	-0.845	-0.457	-0.009
2.200	-1.234	-1.046	-0.876	-0.709	-0.413	-0.011
2.400	-1.144	-0.640	-0.569	-0.548	-0.356	0.030
2.600	-0.963	-0.228	-0.225	-0.373	-0.314	0.064
2.800	-0.647	0.141	0.138	-0.181	-0.278	0.095
3.000	-0.301	0.428	0.497	0.035	-0.231	0.229
3.200	-0.045	0.586	0.802	0.250	-0.191	0.238
3.400	0.151	0.613	1.026	0.453	-0.152	0.210
3.600	0.301	0.513	1.141	0.610	-0.163	0.029
3.800	0.361	0.260	1.208	0.783	-0.256	-0.368
4.000	0.331	-0.417	1.203	1.130	-0.090	-0.517
4.200	0.196	-0.977	0.910	1.344	0.311	-0.052
4.400	0.0	-1.258	0.471	1.306	0.356	0.142
4.600	-0.226	-1.372	0.067	1.102	0.388	0.230
4.800	-0.467	-1.391	-0.265	0.960	0.506	0.217
5.000	-0.692	-1.269	-0.573	0.767	0.590	0.181
5.200	-0.983	-1.014	-0.826	0.532	0.676	0.177
5.400	-1.084	-0.635	-0.948	0.247	0.702	0.142
5.600	-1.069	-0.198	-0.945	-0.055	0.704	0.100
5.800	-0.918	0.259	-0.792	-0.361	0.670	-0.080
6.000	-0.647	0.690	-0.609	-0.609	0.665	-0.406
6.200	-0.286	0.879	-0.216	-1.004	0.594	-0.365
6.400	0.105	0.981	0.145	-1.142	0.504	-0.226
6.600	0.421	0.938	0.486	-1.202	0.435	-0.171
6.800	0.647	0.783	0.761	-1.214	0.345	-0.169
7.000	0.737	0.505	0.976	-1.210	0.190	-0.131
7.200	0.722	0.192	1.028	-0.988	0.076	-0.189
7.400	0.467	-0.140	0.938	-0.746	0.092	0.136
7.600	0.120	-0.470	0.783	-0.538	-0.111	-0.039
7.800	-0.226	-0.739	0.526	-0.147	-0.279	-0.404
8.000	-0.572	-0.884	0.190	0.155	-0.472	-0.400
8.200	-0.843	-0.870	-0.173	0.451	-0.515	-0.463
8.400	-1.008	-0.686	-0.572	0.730	-0.756	-0.294
8.600	-1.084	-0.413	-0.874	0.929	-0.795	-0.243
8.800	-0.993	-0.079	-1.053	1.057	-0.843	-0.180
9.000	-0.737	0.289	-1.113	1.106	-0.861	-0.110
9.200	-0.391	0.638	-1.044	1.070	-0.852	-0.023
9.400	-0.060	0.906	-0.882	0.980	-0.836	-0.069
9.600	0.271	1.063	-0.581	0.749	-0.741	0.038
9.800	0.557	1.085	-0.232	0.489	-0.644	0.134
10.000	0.707	1.004	0.134	0.239	-0.576	0.453

TABLE 3 (Continued)

Real (A^{VV})

KR	BISTATIC ANGLE (DEGREES) 0	30	60	90	120	150
10.200	0.737	0.745	0.465	-0.040	-0.400	0.272
10.400	0.632	0.442	0.772	-0.325	-0.229	0.310
10.600	0.406	0.027	0.958	-0.607	-0.106	0.162
10.800	0.105	-0.327	1.014	-0.784	0.022	0.183
11.000	-0.196	-0.659	0.980	-0.951	0.271	0.468
11.200	-0.542	-0.874	0.839	-0.991	0.486	0.509
11.400	-0.753	-0.940	0.592	-0.948	0.653	0.526
11.600	-0.933	-0.861	0.310	-0.835	0.749	0.591
11.800	-0.978	-0.629	-0.044	-0.648	0.880	0.515
12.000	-0.888	-0.304	-0.377	-0.410	0.947	0.515
12.200	-0.677	0.081	-0.675	-0.128	1.001	0.504
12.400	-0.331	0.440	-0.873	0.129	0.972	0.561
12.600	0.0	0.771	-0.962	0.409	0.972	0.447
12.800	0.346	0.969	-0.947	0.640	0.899	0.398
13.000	0.617	1.014	-0.799	0.781	0.784	0.445
13.200	0.783	0.916	-0.586	0.908	0.652	0.358
13.400	0.813	0.675	-0.295	0.928	0.561	0.091
13.600	0.662	0.362	0.039	0.861	0.361	0.296
13.800	0.421	-0.022	0.365	0.730	0.190	0.393
14.000	0.090	-0.396	0.669	0.543	0.027	0.363
14.200	-0.256	-0.717	0.854	0.323	-0.244	0.158
14.400	-0.587	-0.957	0.947	0.035	-0.445	0.110
14.600	-0.858	-1.056	0.929	-0.258	-0.645	0.045
14.800	-0.978	-0.992	0.811	-0.500	-0.796	-0.022
15.000	-0.963	-0.784	0.601	-0.726	-0.925	-0.056
15.200	-0.828	-0.463	0.324	-0.896	-1.034	-0.118
15.400	-0.557	-0.096	-0.010	-0.977	-1.079	-0.197
15.600	-0.196	0.283	-0.330	-0.989	-1.105	-0.176
15.800	0.166	0.600	-0.637	-0.908	-1.055	-0.206
16.000	0.497	0.827	-0.861	-0.740	-0.989	-0.258
16.200	0.737	0.935	-0.986	-0.532	-0.892	-0.259
16.400	0.858	0.901	-0.988	-0.261	-0.749	-0.336
16.600	0.813	0.746	-0.871	-0.007	-0.621	-0.308
16.800	0.647	0.433	-0.669	0.324	-0.433	-0.401
17.000	0.361	0.075	-0.384	0.600	-0.250	-0.574
17.200	0.015	-0.308	-0.045	0.798	-0.083	-0.605
17.400	-0.331	-0.627	0.307	0.960	0.207	-0.498
17.600	-0.647	-0.885	0.614	1.059	0.439	-0.490
17.800	-0.858	-1.010	0.854	1.066	0.628	-0.504
18.000	-0.948	-0.995	0.979	0.998	0.829	-0.489
18.200	-0.903	-0.834	1.002	0.843	0.965	-0.499
18.400	-0.722	-0.555	0.906	0.631	1.067	-0.465
18.600	-0.436	-0.189	0.711	0.337	1.112	-0.533
18.800	-0.090	0.200	0.427	0.031	1.134	-0.524
19.000	0.271	0.557	0.087	-0.278	1.120	-0.534
19.200	0.467	0.834	-0.260	-0.563	1.052	-0.504
19.400	0.632	0.980	-0.576	-0.809	0.963	-0.459
19.600	0.768	0.987	-0.825	-0.993	0.829	-0.437
19.800	0.858	0.847	-0.976	-1.097	0.660	-0.393
20.000	0.918	0.583	-1.002	-1.138	0.495	-0.332

TABLE 4

Imag (A^{VV})

KR	BISTATIC ANGLE (DEGREES) 0	30	60	90	120	150
0.200	0.085	-0.006	-0.004	-0.001	0.000	0.000
0.400	0.421	-0.049	-0.028	-0.007	0.005	0.007
0.600	0.918	-0.146	-0.078	-0.008	0.035	0.046
0.800	1.309	-0.262	-0.115	0.046	0.152	0.187
1.000	1.610	-0.374	-0.123	0.165	0.373	0.452
1.200	1.791	-0.487	-0.140	0.290	0.627	0.764
1.400	1.957	-0.661	-0.252	0.310	0.796	1.008
1.600	1.942	-0.959	-0.558	0.112	0.786	1.133
1.800	1.776	-1.205	-0.854	-0.116	0.745	1.237
2.000	1.475	-1.392	-1.151	-0.413	0.631	1.316
2.200	1.099	-1.392	-1.342	-0.722	0.462	1.382
2.400	0.707	-1.327	-1.465	-1.037	0.243	1.447
2.600	0.346	-1.126	-1.448	-1.297	0.006	1.509
2.800	0.060	-0.815	-1.294	-1.472	-0.230	1.565
3.000	-0.151	-0.531	-1.066	-1.552	-0.461	1.627
3.200	-0.181	-0.139	-0.703	-1.514	-0.671	1.644
3.400	0.015	0.213	-0.285	-1.365	-0.872	1.618
3.600	0.361	0.502	0.160	-1.101	-1.061	1.522
3.800	0.828	0.481	0.566	-0.668	-1.106	1.564
4.000	1.309	0.375	0.753	-0.212	-0.834	2.241
4.200	1.746	0.515	0.799	0.023	-0.921	2.430
4.400	2.077	0.418	0.859	0.261	-1.067	2.365
4.600	2.227	0.218	0.925	0.648	-0.987	2.199
4.800	2.182	-0.103	0.800	1.011	-0.893	2.045
5.000	1.926	-0.433	0.565	1.263	-0.785	1.909
5.200	1.520	-0.672	0.241	1.393	-0.658	1.743
5.400	1.129	-0.893	-0.075	1.444	-0.469	1.587
5.600	0.768	-1.002	-0.378	1.391	-0.246	1.400
5.800	0.467	-1.029	-0.604	1.255	-0.011	1.147
6.000	0.256	-0.857	-0.779	0.953	0.247	0.779
6.200	0.196	-0.683	-0.778	0.681	0.416	1.247
6.400	0.256	-0.272	-0.801	0.377	0.662	0.897
6.600	0.521	0.155	-0.713	0.019	0.897	0.659
6.800	0.722	0.526	-0.509	-0.347	1.074	0.450
7.000	1.084	0.793	-0.214	-0.639	1.129	0.202
7.200	1.400	0.964	0.064	-0.869	1.320	0.009
7.400	1.686	0.975	0.370	-1.111	1.333	-0.324
7.600	1.926	0.792	0.680	-1.185	1.170	-1.051
7.800	2.047	0.540	0.840	-1.181	1.103	-1.138
8.000	2.002	0.173	0.951	-1.119	1.016	-1.150
8.200	1.806	-0.138	0.892	-0.909	0.830	-1.269
8.400	1.505	-0.605	0.875	-0.754	0.660	-1.329
8.600	1.129	-0.862	0.676	-0.503	0.464	-1.509
8.800	0.798	-1.015	0.399	-0.197	0.238	-1.608
9.000	0.482	-1.017	0.073	0.116	-0.008	-1.683
9.200	0.316	-0.867	-0.271	0.416	-0.266	-1.738
9.400	0.166	-0.633	-0.557	0.622	-0.473	-1.825
9.600	0.316	-0.268	-0.80.	0.824	-0.742	-1.753
9.800	0.542	0.129	-0.966	0.945	-0.973	-1.688
10.000	0.888	0.523	-1.046	1.043	-1.107	-1.907

TABLE 4 (Continued)

Imag (A^{VV})

KR	BISTATIC ANGLE (DEGREES) 0	30	60	90	120	150
10.200	1.294	0.812	-0.975	0.951	-1.235	-1.801
10.400	1.701	1.016	-0.824	0.829	-1.263	-1.799
10.600	2.047	1.020	-0.528	0.634	-1.397	-1.645
10.800	2.212	0.867	-0.200	0.399	-1.262	-1.165
11.000	2.212	0.595	0.180	0.142	-1.155	-1.097
11.200	2.107	0.262	0.508	-0.102	-1.053	-1.033
11.400	1.821	-0.111	0.776	-0.351	-0.910	-0.908
11.600	1.475	-0.431	0.954	-0.566	-0.702	-0.757
11.800	1.054	-0.733	1.000	-0.696	-0.514	-0.597
12.000	0.692	-0.921	0.947	-0.808	-0.272	-0.425
12.200	0.421	-0.991	0.770	-0.854	-0.016	-0.258
12.400	0.226	-0.893	0.517	-0.860	0.278	-0.076
12.600	0.256	-0.669	0.179	-0.712	0.521	0.020
12.800	0.391	-0.356	-0.173	-0.552	0.764	0.192
13.000	0.562	0.029	-0.499	-0.321	0.927	0.387
13.200	1.023	0.394	-0.763	-0.091	1.135	0.469
13.400	1.445	0.714	-0.920	0.107	1.251	0.754
13.600	1.776	0.931	-0.997	0.378	1.367	0.911
13.800	2.002	1.015	-0.941	0.615	1.416	1.001
14.000	2.137	0.963	-0.764	0.760	1.298	0.854
14.200	2.122	0.753	-0.504	0.846	1.190	0.934
14.400	1.941	0.434	-0.150	0.848	1.080	1.064
14.600	1.731	0.062	0.202	0.801	0.927	1.113
14.800	1.400	-0.317	0.539	0.698	0.725	1.223
15.000	1.023	-0.652	0.800	0.528	0.523	1.251
15.200	0.707	-0.875	0.968	0.322	0.283	1.274
15.400	0.497	-0.979	1.022	0.093	0.006	1.309
15.600	0.361	-0.930	0.960	-0.185	-0.239	1.289
15.800	0.286	-0.761	0.775	-0.436	-0.475	1.286
16.000	0.421	-0.459	0.498	-0.642	-0.728	1.292
16.200	0.662	-0.080	0.169	-0.800	-0.925	1.253
16.400	1.038	0.307	-0.185	-0.923	-1.106	1.192
16.600	1.415	0.660	-0.509	-0.951	-1.290	1.158
16.800	1.701	0.908	-0.791	-0.905	-1.348	0.912
17.000	1.927	1.026	-0.958	-0.823	-1.387	0.874
17.200	2.062	0.980	-1.028	-0.643	-1.262	1.034
17.400	2.062	0.806	-0.975	-0.388	-1.179	0.923
17.600	1.896	0.511	-0.606	-0.123	-1.088	0.781
17.800	1.580	0.142	-0.541	0.142	-0.943	0.647
18.000	1.249	-0.232	-0.205	0.413	-0.769	0.510
18.200	0.903	-0.581	0.148	0.652	-0.548	0.377
18.400	0.632	-0.841	0.473	0.829	-0.324	0.271
18.600	0.421	-0.986	0.740	0.980	-0.052	0.084
18.800	0.301	-0.977	0.931	1.036	0.207	-0.041
19.000	0.361	-0.819	1.005	1.022	0.454	-0.189
19.200	0.497	-0.543	0.965	0.920	0.688	-0.323
19.400	0.722	-0.191	0.804	0.747	0.924	-0.468
19.600	1.069	0.191	0.554	0.520	1.101	-0.591
19.800	1.520	0.543	0.238	0.263	1.251	-0.746
20.000	2.077	0.809	-0.104	-0.037	1.312	-0.715

TABLE 5

$\sigma^{HH}/\pi R^2$

KR	BISTATIC ANGLE (DEGREES) 0	30	60	90	120	150
0.200	0.007	0.005	0.003	0.001	0.000	0.000
0.400	0.183	0.077	0.043	0.013	0.001	0.002
0.600	0.881	0.370	0.195	0.056	0.002	0.015
0.800	1.824	1.096	0.528	0.126	0.000	0.084
1.000	2.811	2.115	0.926	0.188	0.003	0.227
1.200	3.570	3.011	1.182	0.205	0.024	0.425
1.400	4.441	3.492	1.249	0.203	0.073	0.615
1.600	4.697	3.606	1.260	0.257	0.140	0.738
1.800	4.394	3.402	1.263	0.372	0.256	0.928
2.000	3.662	2.931	1.327	0.599	0.409	1.133
2.200	2.730	2.227	1.562	0.999	0.605	1.323
2.400	1.809	1.623	1.807	1.357	0.767	1.543
2.600	1.048	1.224	2.103	1.649	0.875	1.756
2.800	0.422	1.061	2.375	1.809	0.914	1.942
3.000	0.113	1.031	2.400	1.790	0.989	2.399
3.200	0.035	1.038	2.426	1.730	0.999	2.554
3.400	0.023	1.037	2.257	1.593	1.085	2.658
3.600	0.221	1.042	1.942	1.327	1.329	2.662
3.800	0.816	1.272	2.280	0.670	1.679	3.158
4.000	1.824	1.192	3.823	0.325	1.019	5.067
4.200	3.086	0.579	3.027	1.251	0.563	6.115
4.400	4.314	0.351	2.211	1.567	0.718	7.319
4.600	5.013	0.102	1.680	2.058	0.578	5.916
4.800	4.980	0.092	1.312	2.391	0.611	4.836
5.000	4.191	0.294	1.140	2.520	0.662	4.286
5.200	3.181	0.894	0.990	2.533	0.662	3.886
5.400	2.448	1.474	0.912	2.440	0.670	3.604
5.600	1.731	2.046	0.785	2.342	0.668	3.396
5.800	1.061	2.126	0.704	2.285	0.655	3.369
6.000	0.484	1.690	0.926	1.999	0.382	3.754
6.200	0.120	4.308	0.875	1.292	1.746	1.842
6.400	0.077	4.160	0.298	1.802	1.595	1.736
6.600	0.355	3.618	0.117	1.986	1.555	1.619
6.800	0.941	3.022	0.160	2.023	1.539	1.526
7.000	1.718	2.334	0.298	1.904	1.579	1.462
7.200	2.481	2.000	0.364	1.633	1.945	1.094
7.400	3.059	1.853	0.319	1.586	2.058	0.715
7.600	3.726	1.225	0.456	2.409	1.332	0.664
7.800	4.241	0.469	0.776	2.414	1.154	1.213
8.000	4.334	0.111	1.104	2.247	1.223	1.247
8.200	3.972	0.382	1.030	1.969	0.910	0.148
8.400	3.282	0.191	1.015	1.560	1.183	1.589
8.600	2.448	0.378	1.098	1.654	1.417	1.721
8.800	1.623	0.653	1.229	1.661	1.495	1.828
9.000	0.776	0.900	1.389	1.647	1.518	1.936
9.200	0.253	1.092	1.587	1.602	1.511	2.050
9.400	0.031	1.290	1.877	1.410	1.429	2.054
9.600	0.173	1.346	2.040	1.267	1.453	2.231
9.800	0.604	1.348	2.055	1.042	1.405	2.419
10.000	1.289	1.389	2.357	1.332	2.000	2.256

TABLE 5 (Continued)

$\sigma^{HH}/\pi R^2$

KR·	BISTATIC ANGLE (DEGREES) 0	30	60	90	120	150
10.200	2.219	1.418	2.266	1.259	2.076	1.718
10.400	3.292	1.634	2.179	0.669	2.418	3.085
10.600	4.355	1.737	2.066	0.977	2.511	2.463
10.800	4.906	2.202	2.175	1.324	1.884	1.675
11.000	4.933	2.348	1.883	1.119	1.581	1.354
11.200	4.733	2.301	1.619	0.961	1.573	1.342
11.400	3.883	2.139	1.450	0.852	1.617	1.272
11.600	3.046	2.009	1.412	0.813	1.721	1.153
11.800	2.067	1.677	1.324	0.700	1.756	1.073
12.000	1.268	1.266	1.235	0.605	1.790	0.997
12.200	0.636	0.658	1.014	0.481	1.755	1.021
12.400	0.161	0.593	1.014	0.799	0.776	0.815
12.600	0.065	0.134	0.931	0.404	2.073	0.456
12.800	0.273	0.085	0.691	0.426	2.010	0.473
13.000	0.819	0.143	0.615	0.453	2.014	0.451
13.200	1.660	0.345	0.496	0.500	1.983	0.425
13.400	2.748	0.497	0.470	0.790	2.215	0.709
13.600	3.593	1.223	0.317	0.532	2.373	0.518
13.800	4.184	1.512	0.361	0.625	2.527	0.749
14.000	4.576	1.979	0.316	0.462	2.092	0.845
14.200	4.569	2.314	0.436	0.319	1.867	0.635
14.400	4.114	2.254	0.529	0.345	2.024	0.684
14.600	3.732	2.377	0.586	0.234	1.878	0.596
14.800	2.916	2.320	0.564	0.461	1.893	0.654
15.000	1.975	2.006	0.705	0.462	2.014	0.826
15.200	1.186	1.658	0.848	0.556	1.980	0.910
15.400	0.557	1.432	0.943	0.607	1.978	0.997
15.600	0.169	1.250	1.062	0.664	1.962	1.103
15.800	0.109	1.185	1.109	0.699	2.000	1.279
16.000	0.424	1.123	1.285	0.634	2.019	1.237
16.200	0.962	1.010	1.483	0.713	2.107	1.191
16.400	1.814	0.925	1.642	0.805	2.100	1.223
16.600	2.662	0.802	1.873	1.103	1.938	0.810
16.800	3.311	0.639	1.847	0.751	2.479	1.366
17.000	3.842	0.538	1.784	0.777	2.438	1.220
17.200	4.252	0.396	1.993	0.711	2.263	1.466
17.400	4.361	0.284	1.941	0.914	2.000	1.450
17.600	4.015	0.286	1.829	1.039	2.005	1.372
17.800	3.233	0.396	1.727	1.112	2.026	1.308
18.000	2.460	0.759	1.599	1.215	1.999	1.275
18.200	1.631	1.103	1.530	1.269	2.021	1.225
18.400	0.921	1.395	1.410	1.473	2.104	1.494
18.600	0.368	1.698	1.514	1.308	2.007	0.957
18.800	0.099	2.094	1.430	1.275	2.144	0.922
19.000	0.204	2.333	1.345	1.369	2.084	0.875
19.200	0.464	2.420	1.215	1.467	2.016	0.813
19.400	0.921	2.550	1.119	1.522	2.084	0.921
19.600	1.731	2.205	0.881	1.540	2.043	0.915
19.800	3.047	1.863	0.757	1.477	1.974	0.944
20.000	5.156	1.617	0.639	1.419	2.289	0.789

TABLE 6

$\sigma^{VV}/\pi R^2$

KR	BISTATIC ANGLE (DEGREES) 0	30	60	90	120	150
0.200	0.007	0.005	0.004	0.002	0.001	0.000
0.400	0.183	0.082	0.058	0.033	0.016	0.007
0.600	0.881	0.403	0.284	0.168	0.088	0.046
0.800	1.824	1.224	0.868	0.543	0.329	0.207
1.000	2.811	2.413	1.666	1.058	0.709	0.511
1.200	3.570	3.494	2.289	1.428	1.070	0.892
1.400	4.441	4.098	2.489	1.442	1.227	1.215
1.600	4.697	4.355	2.551	1.203	1.034	1.333
1.800	4.394	4.262	2.541	0.975	0.855	1.540
2.000	3.662	3.881	2.605	0.884	0.607	1.732
2.200	2.730	3.033	2.570	1.023	0.384	1.910
2.400	1.809	2.169	2.470	1.376	0.185	2.094
2.600	1.048	1.320	2.148	1.821	0.098	2.282
2.800	0.422	0.685	1.692	2.201	0.130	2.457
3.000	0.113	0.465	1.383	2.410	0.266	2.700
3.200	0.035	0.362	1.138	2.356	0.487	2.760
3.400	0.023	0.421	1.134	2.068	0.783	2.663
3.600	0.221	0.515	1.328	1.585	1.153	2.317
3.800	0.816	0.299	1.780	1.059	1.290	2.581
4.000	1.824	0.314	2.013	1.321	0.704	5.288
4.200	3.086	1.220	1.465	1.806	0.946	5.907
4.400	4.314	1.759	0.960	1.773	1.266	5.615
4.600	5.013	1.929	0.860	1.635	1.126	4.889
4.800	4.980	1.947	0.711	1.944	1.054	4.231
5.000	4.191	1.797	0.647	2.183	0.965	3.675
5.200	3.181	1.479	0.741	2.224	0.889	3.070
5.400	2.448	1.202	0.905	2.147	0.712	2.538
5.600	1.731	1.043	1.036	1.937	0.556	1.971
5.800	1.061	1.125	0.992	1.705	0.448	1.322
6.000	0.484	1.212	0.977	1.280	0.503	0.771
6.200	0.120	1.238	0.651	1.472	0.526	1.687
6.400	0.077	1.037	0.662	1.446	0.692	0.856
6.600	0.355	0.904	0.745	1.446	0.994	0.463
6.800	0.941	0.390	0.838	1.593	1.273	0.231
7.000	1.718	0.884	0.999	1.873	1.312	0.058
7.200	2.481	0.967	1.0[illegible]	1.730	1.747	0.036
7.400	3.059	0.970	1.0[illegible]	1.790	1.785	0.123
7.600	3.726	0.848	1.075	1.693	1.382	1.106
7.800	4.241	0.838	0.983	1.415	1.294	1.459
8.000	4.334	0.812	0.940	1.275	1.256	1.483
8.200	3.972	0.777	0.826	1.029	0.954	1.826
8.400	3.282	0.837	1.093	1.101	1.006	1.853
8.600	2.448	0.915	1.221	1.116	0.848	2.335
8.800	1.623	1.036	1.268	1.157	0.767	2.618
9.000	0.776	1.117	1.243	1.236	0.741	2.846
9.200	0.253	1.159	1.164	1.318	0.796	3.021
9.400	0.031	1.222	1.088	1.348	0.922	3.336
9.600	0.173	1.203	0.988	1.241	1.100	3.075
9.800	0.604	1.193	0.988	1.132	1.361	2.867
10.000	1.289	1.281	1.112	1.145	1.556	3.842

TABLE 6 (Continued)

$\sigma^{VV}/\pi R^2$

KR	BISTATIC ANGLE (DEGREES) 0	30	60	90	120	150
10.200	2.219	1.214	1.166	0.905	1.686	3.318
10.400	3.292	1.228	1.275	0.793	1.647	3.332
10.600	4.355	1.041	1.196	0.770	1.963	2.733
10.800	4.906	0.858	1.068	0.774	1.593	1.390
11.000	4.933	0.788	0.993	0.925	1.409	1.423
11.200	4.733	0.832	0.961	0.992	1.346	1.325
11.400	3.883	0.896	0.952	1.022	1.254	1.102
11.600	3.046	0.928	1.006	1.018	1.053	0.922
11.800	2.067	0.933	1.002	0.905	1.039	0.622
12.000	1.268	0.941	1.039	0.821	0.971	0.446
12.200	0.636	0.988	1.049	0.746	1.003	0.321
12.400	0.161	0.992	1.030	0.757	1.022	0.321
12.600	0.065	1.043	0.957	0.675	1.216	0.200
12.800	0.273	1.065	0.927	0.714	1.392	0.195
13.000	0.819	1.028	0.888	0.712	1.474	0.347
13.200	1.660	0.995	0.927	0.833	1.713	0.348
13.400	2.748	0.966	0.934	0.873	1.879	0.576
13.600	3.593	0.997	0.995	0.883	1.998	0.918
13.800	4.184	1.030	1.018	0.911	2.040	1.156
14.000	4.576	1.084	1.032	0.873	1.684	0.860
14.200	4.569	1.081	0.984	0.820	1.477	0.898
14.400	4.114	1.105	0.920	0.720	1.364	1.143
14.600	3.732	1.119	0.904	0.707	1.275	1.241
14.800	2.916	1.085	0.948	0.737	1.159	1.497
15.000	1.975	1.039	1.002	0.806	1.129	1.568
15.200	1.186	0.981	1.043	0.906	1.148	1.637
15.400	0.557	0.968	1.044	0.962	1.164	1.753
15.600	0.169	0.945	1.030	1.013	1.278	1.693
15.800	0.109	0.939	1.005	1.015	1.339	1.696
16.000	0.424	0.894	0.989	0.959	1.509	1.736
16.200	0.982	0.881	1.005	0.923	1.650	1.636
16.400	1.814	0.906	1.010	0.920	1.783	1.533
16.600	2.662	0.992	1.018	0.904	2.050	1.436
16.800	3.311	1.012	1.074	0.923	2.005	0.992
17.000	3.842	1.058	1.065	1.037	1.986	1.093
17.200	4.252	1.056	1.058	1.050	1.600	1.436
17.400	4.361	1.055	1.046	1.072	1.433	1.100
17.600	4.015	1.045	1.026	1.137	1.376	0.851
17.800	3.233	1.040	1.023	1.157	1.283	0.673
18.000	2.460	1.044	1.001	1.167	1.279	0.499
18.200	1.631	1.034	1.025	1.136	1.233	0.391
18.400	0.921	1.016	1.044	1.085	1.244	0.290
18.600	0.368	1.009	1.053	1.074	1.240	0.292
18.800	0.099	0.995	1.049	1.074	1.328	0.276
19.000	0.204	0.982	1.018	1.121	1.459	0.321
19.200	0.464	0.991	0.998	1.162	1.579	0.359
19.400	0.921	0.996	0.979	1.212	1.780	0.430
19.600	1.731	1.010	0.988	1.257	1.898	0.540
19.800	3.047	1.012	1.010	1.273	2.000	0.712
20.000	5.156	0.994	1.015	1.296	1.965	0.622

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Tables of the electromagnetic scattering amplitude and cross section of a conducting hemisphere for nose-on incidence are presented as a function of frequency, bistatic angle and polarization. The tables give the real and imaginary parts of the scattering amplitude and the radar cross section normalized to πR^2 (R = hemisphere radius). Results are shown for kR ($k = 2\pi/\lambda$) from 0.2 to 20.0 in steps of 0.2, for bistatic angles from 0° to 150° in steps of 30° and for both HH and VV polarizations.

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